NPOESS I

# The NPOESS (National Polar-orbiting Operational Environmental Satellite System): A Program Overview and Status Update



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**Abstract – An overview of the NPOESS program will be presented with a brief history and current status of the program, and with an introduction to the individual sensors under development by the Integrated Program Office as well as future plans for transition to full operational capability.**

## I. WHAT IS NPOESS?

The past few decades have seen a tremendous growth in the use of weather satellites for both civilian and military applications. The maturation of visible-infrared imagery from geosynchronous and polar orbits has become familiar to vast television audiences and military planners as well as geophysical, oceanographic, and atmospheric scientists.

After the early TIROS (Television and Infrared Observation Satellite) civilian weather satellites in the 1960s, the U.S. Air Force developed and operated their own distinct military operational environmental satellites starting in 1965 under the Defense Meteorological Satellite Program (DMSP) for exclusive use for defense. The NOAA civilian polar-orbiting operational environmental satellites also evolved to become the POES (Polar-orbiting Operational Environmental Satellite) program. More background is in [1].

## II. WHY WAS NPOESS FORMED?

During the last decade, the two U.S. civilian and military systems, POES and DMSP, have evolved to use a somewhat similar spacecraft bus, but have different instrument suites. Many government studies had been conducted to assess the value of converging the two systems into a single system. Most studies recommended retaining the separate systems. A 1993 tri-agency study by DoD, NOAA, and NASA recommended that a single converged system should replace the current separate systems.

A Presidential Decision Directive (PDD), signed in May of 1994, directed the convergence of the polar orbiting weather satellites systems into a single national system. The Integrated Program Office (IPO) within NOAA was established in October 1994 as a result of the signing of a tri-agency Memorandum of Agreement (MOA) in May 1994. The new converged system was identified as the National Polar-orbiting Operational Environmental Satellite System (NPOESS). The IPO is staffed with representatives of NOAA, Department of Defense and NASA. This unique tri-agency office has the mission to provide a converged polar-orbiting operational, environmental satellite system that meets user community requirements while saving an anticipated $1.8 Billion over the life of the NPOESS program.

As part of the mission, the IPO is also to incorporate appropriate NASA technology for the NPOESS for risk reduction and cost savings. The NPOESS spacecraft will be carrying several adopted and/or adopted payloads to support the NPOESS mission. See [1]. The NPOESS will also incorporate, where appropriate, international cooperation, in particular, with EUMETSAT and their METOP system.

Of course, the NPOESS will not be instantaneously developed and deployed. NPOESS has grown from the roots of the DMSP and POESS program. Figure 1 is a notional evolution of the NPOESS from the current systems to an intermediate constellation to a final configuration. Currently, the DMSP and POES are both operating two satellites. In 2005, POES will operate a single satellite with DMSP operating two. EUMETSAT will also have their first METOP satellite in operation in the same time frame. Initial Operational Capability (IOC) will begin in 2013 with the first launch in 2009. An NPOESS "lite sat" and the METOP satellite will compliment the two NPOESS satellites.

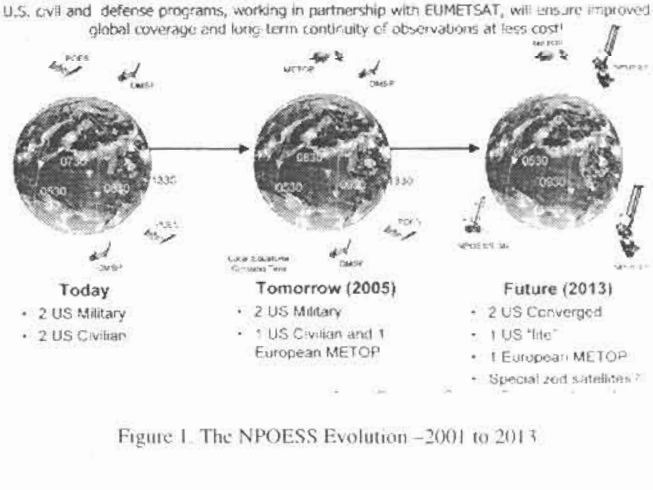


Figure 1. The NPOESS Evolution –2001 to 2013

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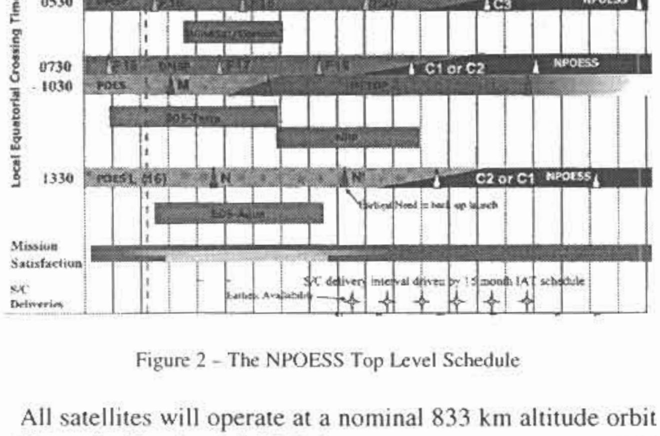



Figure 2 – The NPOESS Top Level Schedule

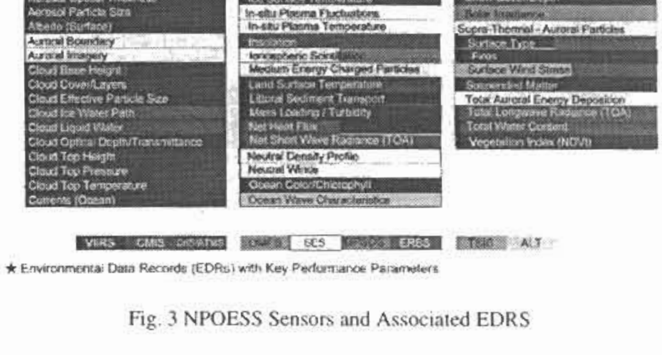
All satellites will operate at a nominal 833 km altitude orbit with an inclination of 98.7 degrees (sun-synchronous) and have nodal crossing times to minimize critical revisit times.

Figure 2 outlines the current schedule. The schedule for the transition from the current two-satellite system to the optimized, converged NPOESS is based on the availability of the current system satellites. All launch dates are approximate. The last DMSP, F20, is scheduled for launch in 2009, and the last POES, "N'", in 2008. The N' (N prime) mission is the earliest need date for NPOESS to be able to provide a backup satellite. The first NPOESS launch is in 2010 after the METOP launch.

Note that the NPOESS Preparatory Project (NPP) bridges the NASA Terra and AQUA missions and NPOESS. Since the civilian and military operational requirements have been converged, the science community will also be supported through the NPP. Once NPOESS satellites are in production, they will be delivered on approximately 15-month centers. This will require that the satellites could be stored up to 8 years before launch for a 7-year orbital mission. This will require high reliability at the sensor level.

### III. HOW IS THE NPOESS PROGRAM EXECUTED?

As previously mentioned, the user community, through a process external to the IPO, established their joint requirements in the Integrated Operational Requirements Document (IORD). As a result, a total of 59 data products and 9 enhanced data products were identified for inclusion into the NPOESS program. From the IORD, the IPO assigned primary responsibility to the NPOESS major sensors. Figure 3 shows the relationship among the IORD EDRs and the NPOESS sensors. Notice that some sensors are directly from NASA for low risk and cost, and data continuity. Additional information on NPOESS can be instrument development is found in [1], [2], [3], [4], [5], and [6].




★ Environmental Data Records (EDRs) with Key Performance Parameters

Fig. 3 NPOESS Sensors and Associated EDRS

### IV. WHAT IS THE NPOESS ACQUISITION STRATEGY?

The acquisition strategy for NPOESS has been to reduce the development risks and costs of the program first by developing the high-risk payloads first and then complete the systems development, integration, and test of the space segment, the $C^3I$ segment, and the data processing segment.

The Payload Contracts are relying on a new approach to acquiring a sensor. A related paper describes this approach and its advantages in detail at [4]. The main emphasis on the payload effort has been focused on risk reduction with Engineering Development Models available to the eventual system integrator.

The current payload status is summarized in Figure 5. Four of the five major payload contractors have been selected at their PDR. CMIS is nearing its final instrument contractor. Figure 4 is a top-level schedule for the two major contracting activities: payload contracts and systems contracts all managed by the IPO.

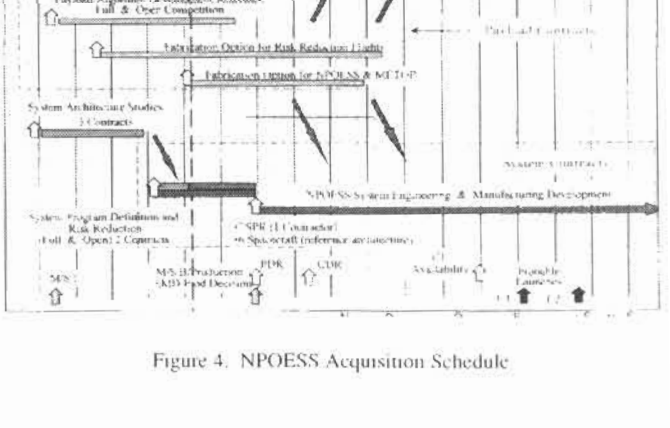



Figure 4. NPOESS Acquisition Schedule

| | SRR System Requirements Review | SFR System Functional Review | PDR Preliminary Design Review | CFI Call For Improvement | CDR Critical Design Review | First Unit Delivery |
|---|---|---|---|---|---|---|
| CrIS Cross-track IR Sounder | 3/98 | 12/98 | 4/99 | 5/99 | 2/02 | 3/04 |
| OMPS Ozone Mapping & Profiler Suite | 11/97 | 8/98 | 1/99 | 2/99 | 3/02 (S) 5/03(A) | 6/04 |
| GPSOS GPS Occultation Sensor | 11/97 | 6/98 | 11/98 | N/A | 1/03 | 3/06 |
| VIIRS Visible/IR Imager Radiometer Suite | 1/99 | 10/99 | 5/00 | 6/00 | 2/02 | 6/04 |
| CMIS Conical Microwave Imager Sounder | 11/98 | 8/99 | 2/01 | 3/01 | 1/03 | 12/05 |

Figure 5. NPOESS Instrument Status.

Additional information concerning the payloads will be presented throughout the IGARSS 2001. [2],[5],[8], and [9].

The current Program Development and Risk Reduction (PDRR) program, has recently been extended to late 2002. At that time, one total system prime contractor shall be selected and proceed to complete the development and fabrication of the ground segments as well as fabricate six spacecraft with the necessary instruments from the payload contracts. The payload contracts will have been transitioned programmatically and contractually to the successful system prime contractor for integration onto the TSPR spacecraft.

## VI. What is being done for risk reduction?

Besides the distinct risk reduction efforts at the NPOESS instrument level which are continuing, the IPO has been active in validating several technological approaches to remote sensing. The use of sensor demonstrations on non-operational platforms offers several benefits. These demonstrations provide early delivery of NPOESS-like data to users. The demonstrations also lower risk to operational users, launch delays due to operational schedules, and they provide lower costs risks when shared across several agencies.

The NASA ER2 is one such valuable platform. It was recently deployed with the NAST (NASA Airborne Sensor Testbed) to Okinawa and Alaska for the WestPac experiment in February/March 2001. This platform has had considerable influence with several of the NPOESS instruments.

A joint IPO and Naval Research Laboratory program is also underway to provide risk reduction support to CMIS. WindSat will measure ocean surface wind speed and direction using a polarimetric radiometer. It will be launched into a near NPOESS orbit (830 km at 98.7-degree inclination). WindSat will have a 25-km spatial resolution. Other measurements will include sea surface temperature, soil moisture, rain rate, ice, and snow characteristics and water vapor. The IPO is one of four major governmental groups supporting this effort.

Another joint risk reduction effort is the NPOESS Preparatory Project (NPP). It is an early flight demonstration of a spacecraft with four of the NPOESS instruments to provide not only sensor risk reduction, but early ground system risk reduction. A paper detailing these significant efforts in NPP may be found in [8, 9].

## V. Conclusion

Over the last seven years, the IPO has successfully managed a complex, multifaceted program. These facets range from the component level technological risk reduction efforts, to complex, state of the art sensors with advanced performance features, to systems level programs charged with converging critical military needs with that of the civilian and science community, while providing long operational life at much less cost.

The first System Program Director, Mr. James Mannen, used to toast the IPO personnel with the reminder, "Here's to success! The only thing they pay us for!" The IPO is pleased to report that success has been ours in the past, and we look confidently to the future.

## References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Recommendation



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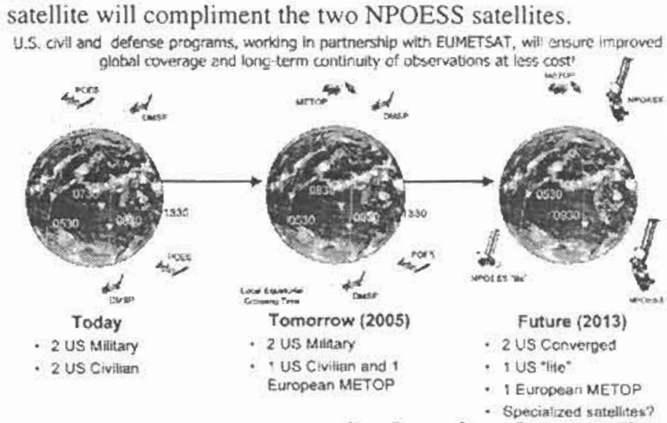


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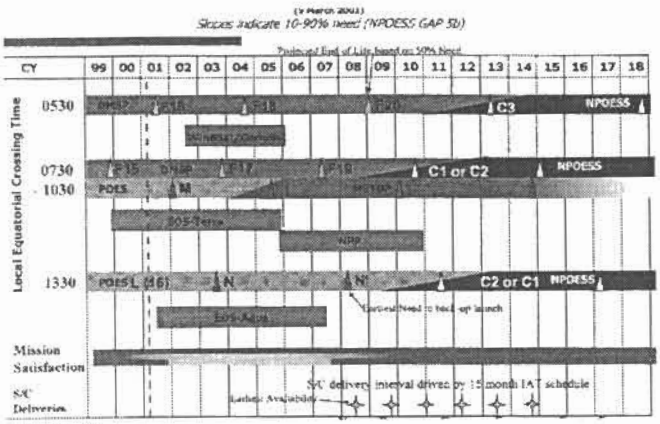


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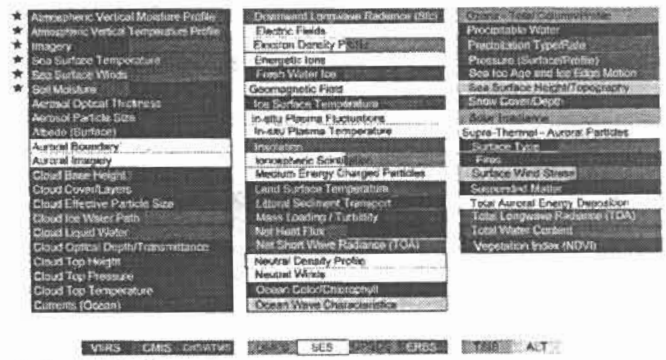


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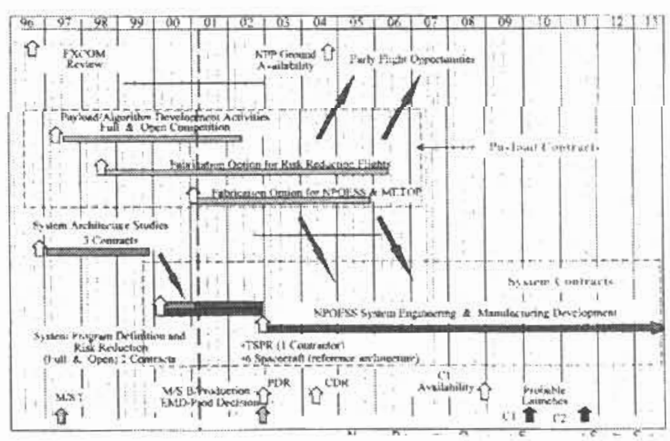

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